



Economic assessment of climate change adaptation options incorporating Bayesian networks: An integrated framework

Gregg, Jay Sterling; Zhou, Qianqian; Åström, Helena Lisa Alexandra; Kaspersen, Per Skougaard; Drews, Martin; Halsnæs, Kirsten; Garrè, Luca; Arnbjerg-Nielsen, Karsten

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Economic assessment of climate change adaptation options incorporating Bayesian networks: An integrated framework

Jay S. Gregg

Qianqian Zhou

Helena Lisa Alexandra Åström

Per Skougaard Kaspersen

Martin Drews

Kirsten Halsnæs

Luca Garre

Karsten Ambjerg-Nielsen

Purpose

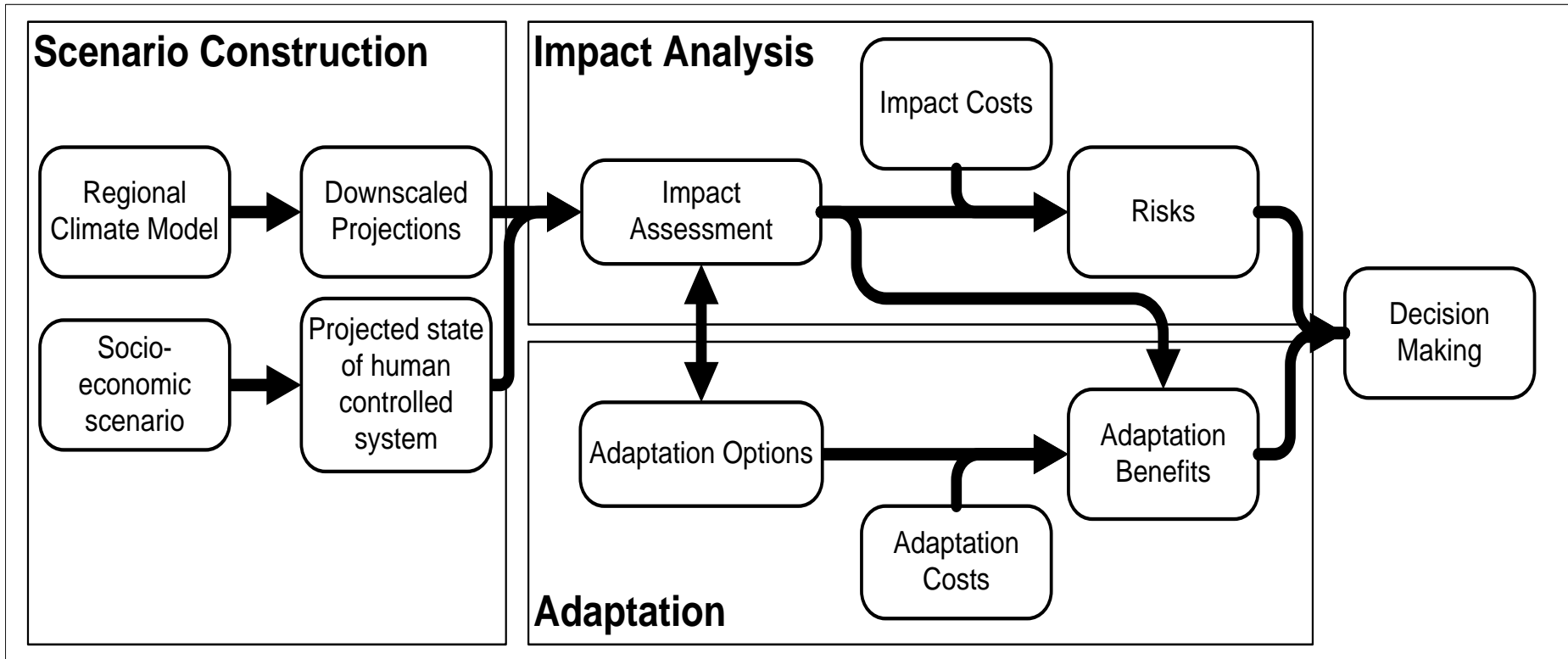
- A framework for climate change adaptation decision making
- Handles complex inter-relationships between impacts and adaptation options
- Flexible structure for applied climate change adaptation decision making.

Outline

- 1. Introduction
 - 1.1 Adaptation in the context of responses to climate change
 - 1.2 Analytical structure
- 2. Scenario construction
 - 2.1. Socioeconomic scenarios
 - 2.2 Climate modeling and climate scenarios
 - 2.3 Future System Scenarios
- 3. Impacts
 - 3.1. Impact Assessment
 - 3.2 Costs
 - 3.3 Risk
- 4. Adaptation
 - 4.1 Identification of Adaptation Options
 - 4.2 Bayesian Network Approach
 - 4.3 Adaptation Costs and Benefits
- 5. Discussion and Conclusions

Introduction

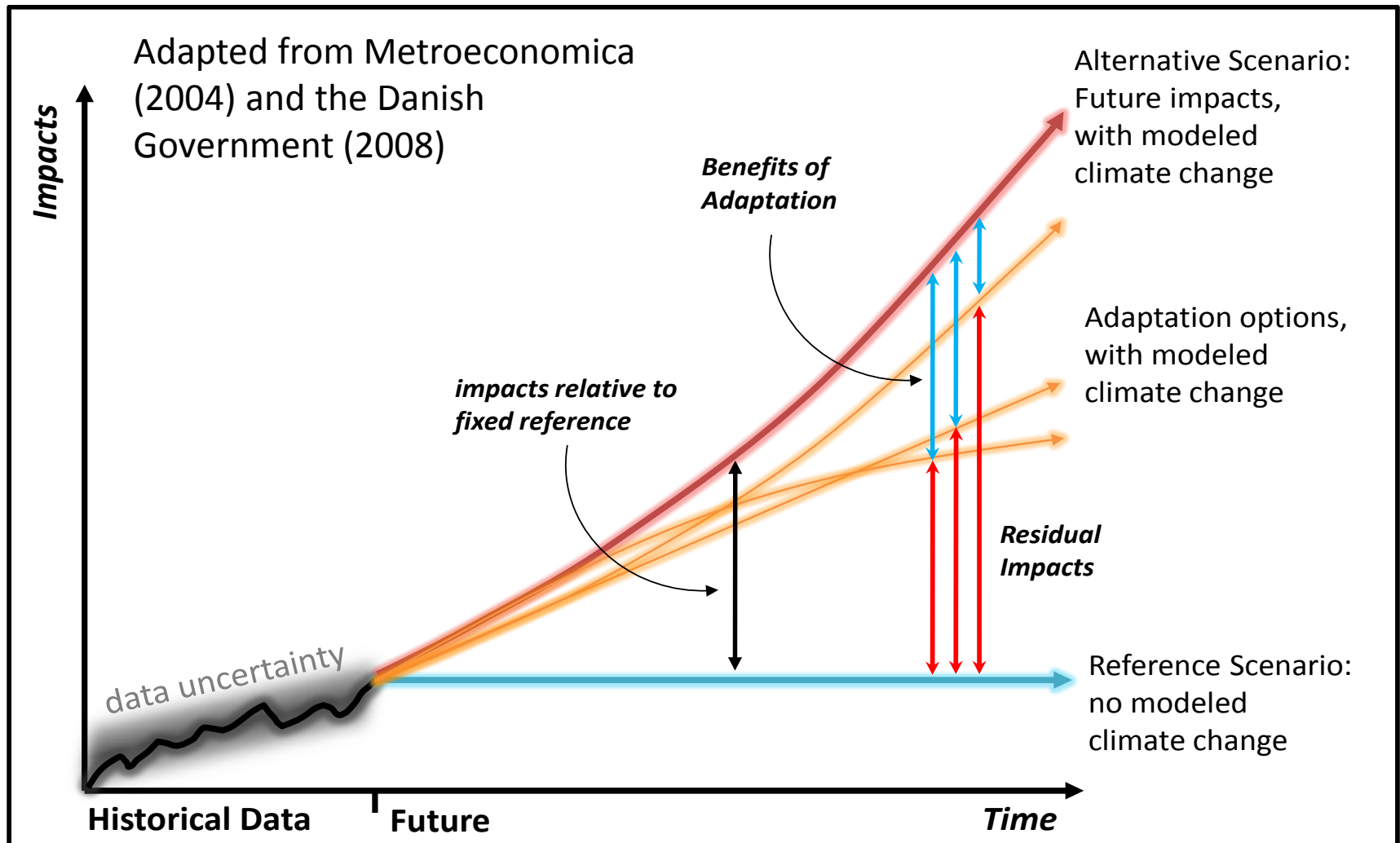
Analytical Structure



Scenarios

- Socioeconomic
 - Question of scale (Global vs. Local)
 - Uncertainty bracketed with scenario analysis
- Climatic
 - Regional climate models
 - Downscaling
- Coupled scenarios

Theoretical scenario development: understanding the risks from climate change and the benefits of adaptation measures.



Impacts

- Assessment
 - characterize change in the climate variable or the extreme weather event (intensity, frequency and duration)
 - obtain spatially explicit information on asset exposure and vulnerability
 - develop asset specific thresholds and damage functions
 - quantify of both the physical and economic impacts
- Costs
 - Cost-Benefit-Analysis; Net Present Value with discounting
 - Multi-Criteria Decision Analysis
- Risk
 - probability of an extreme event multiplied by the consequence of an event

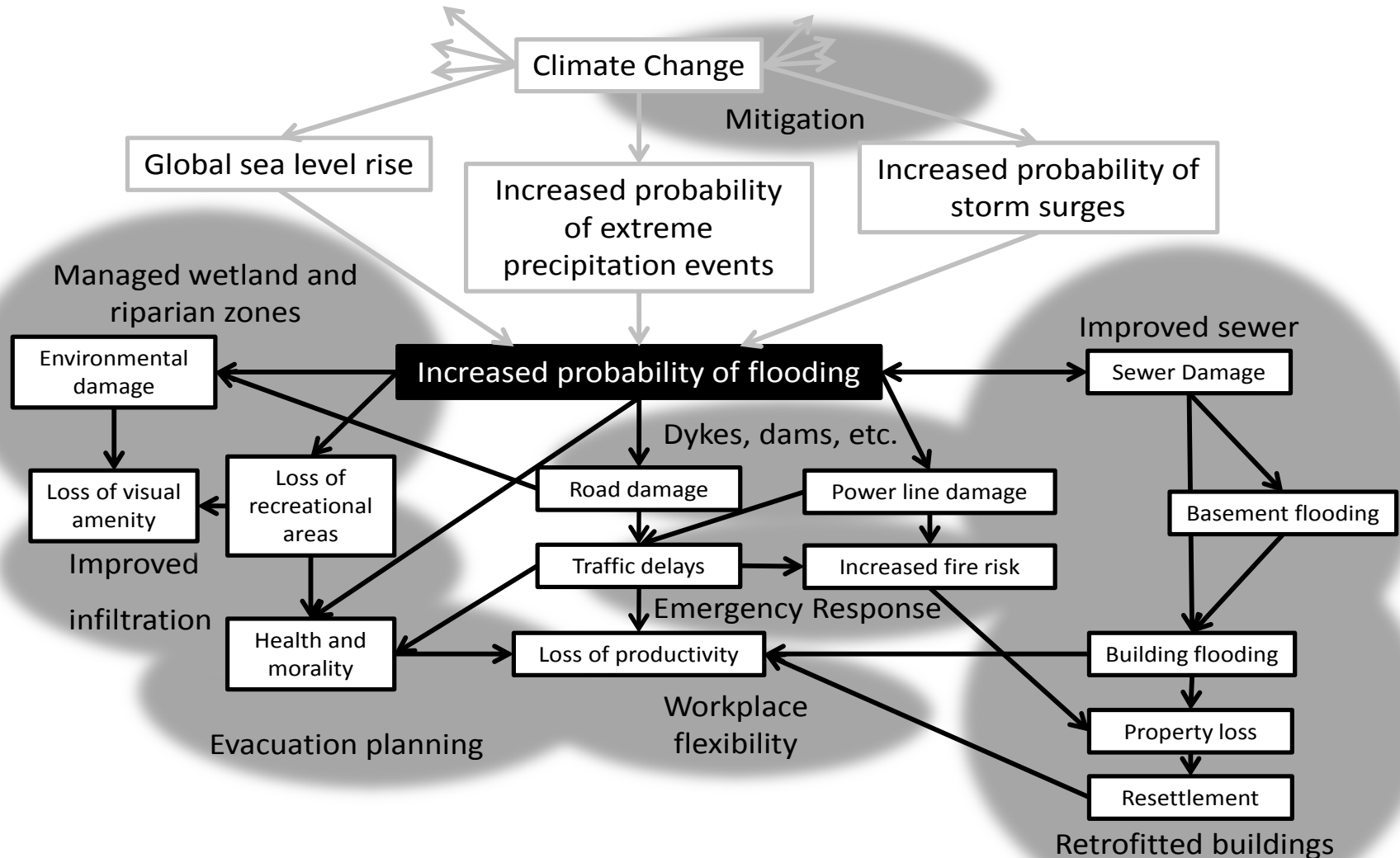
Adaptation Options

- Identification
 - Non-linearity
 - Mapping
- Bayesian Network Approach
 - used to quantify risk in the system
 - determine the probability distribution for each specific impact
 - Static → Dynamic
- Costs and Benefits
 - Priority setting
 - Uncertainty analysis

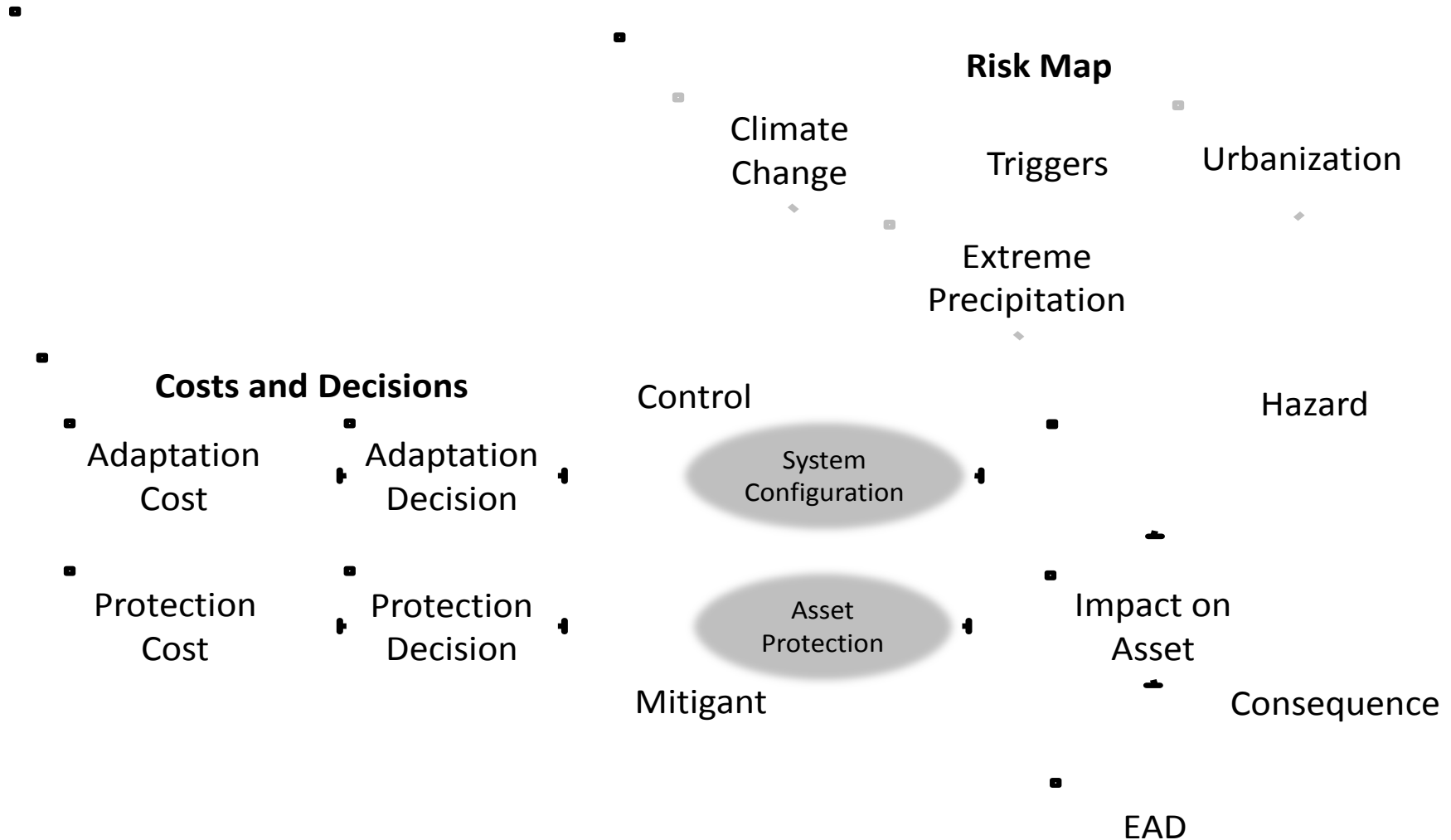
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graph TD
    CC[Climate Change] --> GSLR[Global sea level rise]
    CC --> IEP[Increased probability of extreme precipitation events]
    CC --> IPS[Increased probability of storm surges]
    CC --> Mit[Mitigation]
    
    GSLR --> IPF[Increased probability of flooding]
    IEP --> IPF
    IPS --> IPF
    
    IPF --> ED[Environmental damage]
    IPF --> LRA[Loss of recreational areas]
    IPF --> RD[Road damage]
    IPF --> PLD[Power line damage]
    IPF --> SD[Sewer Damage]
    IPF --> BF[Basement flooding]
    IPF --> H[Mortality]
    IPF --> LP[Loss of productivity]
    IPF --> BFL[Building flooding]
    IPF --> P[Property loss]
    IPF --> R[Resettlement]
    
    ED --> LVA[Loss of visual amenity]
    LVA --> I[Improved infiltration]
    
    LRA --> H
    
    RD --> TD[Traffic delays]
    TD --> E[Emergency Response]
    E --> LP
    
    PLD --> IFR[Increased fire risk]
    IFR --> LP
    
    SD --> BF
    
    BF --> BFL
    
    BFL --> P
    
    P --> R
    
    LP --> W[Workplace flexibility]
    W --> R
    
    R --> RB[Retrofitted buildings]
  
```

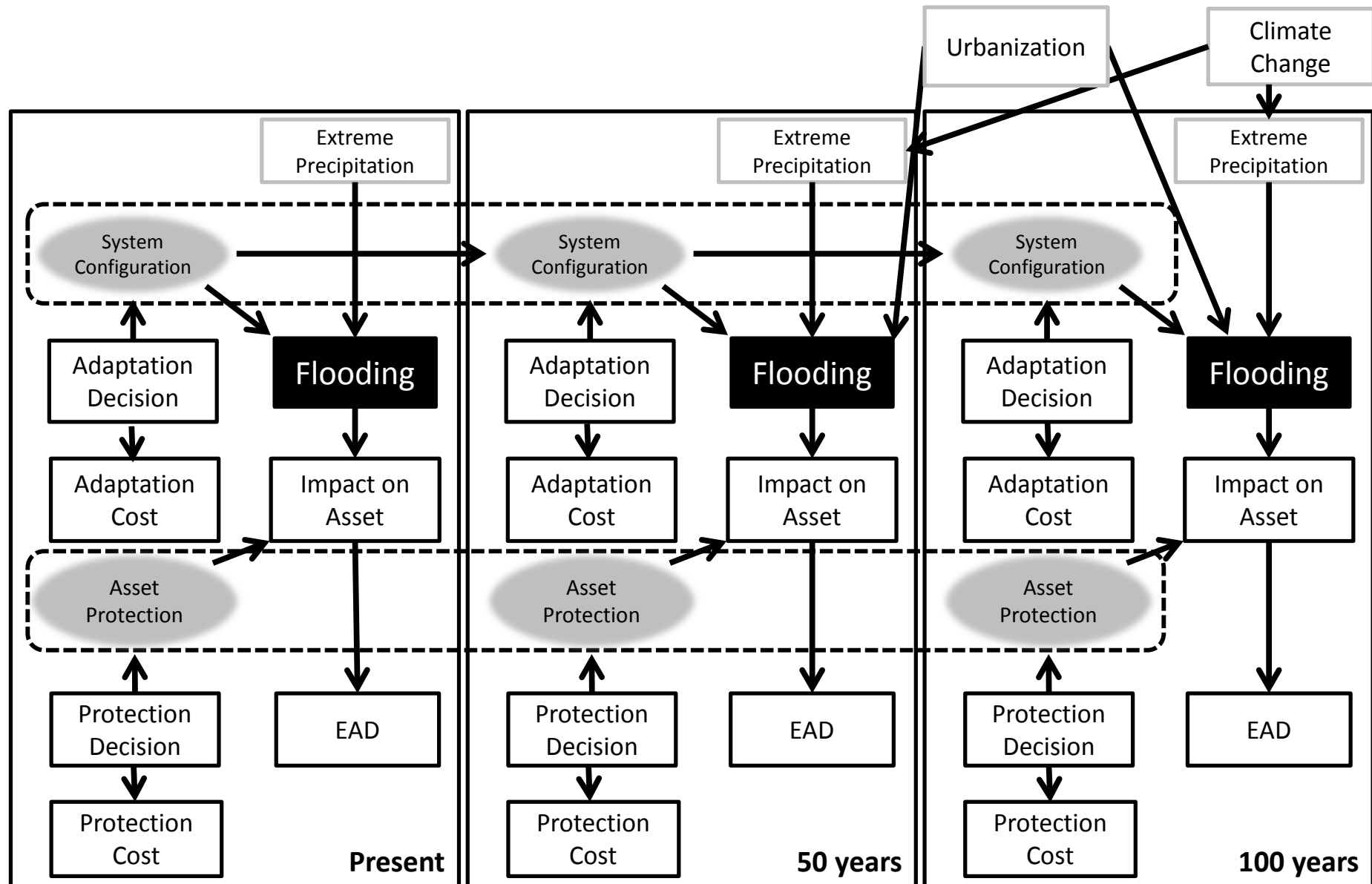
The diagram illustrates the cascading impacts of climate change on flooding and subsequent societal and environmental consequences. The central node is "Increased probability of flooding", which is influenced by "Climate Change" (via "Global sea level rise", "Increased probability of extreme precipitation events", and "Increased probability of storm surges") and "Mitigation". The "Increased probability of flooding" node leads to various impacts: "Environmental damage" (leading to "Loss of visual amenity" and "Improved infiltration"), "Loss of recreational areas", "Road damage" (leading to "Traffic delays" and "Emergency Response"), "Power line damage" (leading to "Increased fire risk"), "Sewer Damage" (leading to "Basement flooding"), "Basement flooding" (leading to "Building flooding"), "Health and mortality", "Loss of productivity", "Building flooding" (leading to "Property loss" and "Resettlement"), and "Property loss" (leading to "Resettlement"). The "Resettlement" node is further linked to "Retrofitted buildings". The diagram also shows "Workplace flexibility" leading to "Resettlement".



A static ID for urban flood risk assessment



Dynamic ID for urban flood risk assessment under non-stationary conditions



Discussion and Conclusions

- + The main strength of the BN approach is the ability to represent complex dynamic systems and the inter-linkages between various nodes in the system.
- complex set of input data required for the analysis & can only deal with continuous values in a limited manner, and these types of variables are common in environmental assessment.

Status

- Submitted May 31, 2013
- One review completed
- Editor requested other reviewer names

Upcoming

- Transportation Analysis of Copenhagen

